PARTICIPATORY AGROFORESTRY DEVELOPMENT IN SWITZERLAND

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Introduction

The traditional agroforestry system 'Streuobst' (Herzog 1998) is still relatively widespread in Switzerland and is formed by fruit trees scattered on grassland, which is mown and/or pastured. Since about 2000, farmers have started to experiment with novel combinations of trees with arable crops, after they hear about agroforestry practices in Germany and France (through the press and internet). Sereke et al. (2014) inventoried these novel agroforestry systems and evaluated their potential productivity and profitability.

In 2014, parallel to the start of the EU FP7 project AGFORWARD (www.agforward.eu), the Swiss Ministry of Agriculture commissioned AGRIDEA, the Swiss national farm extension service, to elaborate extension material for Swiss agroforestry farmers and to establish a participatory research and development network with up to 25 farmers (www.agroforst.ch / www agroforesterie.ch). The overall objectives were:

- To establish a network of farmers with agroforestry demonstration sites;
- To provide agroforestry extension material (website, leaflets, training);
- To record over the years the evolution of pioneer agroforestry sites, both in terms of biophysical growth as in terms of farmer expectations and satisfaction. The last activity already started in 2011 (Kuster et al. 2012) and is pursued in the context of the AGFORWARD and AGRIDEA projects.

Material and methods

In collaboration with the farmers, we recorded the fate of farmer-led agroforestry experiments in terms of bio-physical development, ecosystem services and farmer perceptions about the new agroforestry systems. Key questions include:

- How do the trees develop?
- How do the trees affect crop yield?
- What are the major advantages perceived by the farmers and how does this perception change as the agroforestry plot evolves?
- What are the major constraints perceived by the farmers and how does this perception change as the agroforestry plot evolves?

In addition, we record key tree and crop parameters which will allow, in the long run, the parametrisation of agroforestry models for the plots investigated. Table 1 summarises the characteristics of the agroforestry systems of 11 farmers from the agroforestry network.

Results

The majority of farmers planted fruit trees in their arable fields. The main reasons were that (i) traditional fruit orchards were still widespread and farmers were familiar the management of these fruit trees and (ii) the subsidy rules, which allow claiming direct payments for trees which qualify as Ecological Focus Areas (fruit trees, nut trees, chestnut trees only) favored these trees. Some farmers, however, opted for forest trees, in particular in the French speaking part of Switzerland where they have access to agroforestry extension material from neighboring France. The identity component of these agroforestry systems can be exemplified by the quote of a farmer who pointed that "*This agroforestry plantation is my project, I don't want to adapt it according to the rules of some administrator*".

Farmers formed a network to gather regular updates and participate in training sessions which allows them to learn from formal experts (e.g. training course on tree pruning for agroforestry in winter 2014/15) as well as from each other (Figure 1). The farmer network can be seen as a "novel social structure" designed for knowledge and skill sharing and learning, facilitated by classical extension methods and inputs from research through the ongoing AGFORWARD project. This type of approach has been recently evaluated as very successful in stimulating farmers to

adopt new technologies (Waters-Bayer 2015). The measurements carried out on the agroforestry plots are summarized in Table 2 and further detailed below.

Table 1. Agroforestry plots participating in the Swiss stakeholder group in 2015. The sites marked with an "*" have been selected for long-term monitoring with data recording starting in 2011 (Kuster et al. 2012).

Canton	Municipality	Agroforestry system
Vaud	Arnex sur Orbe	Arable row crops in combination with walnut (*Juglans sp*), wild cherry (*Prunus avium*), wild pear (*Pyrus communis*), linden tree (*Tilia sp*), checker tree (*Sorbus torminalis*), sorb trees (*Sorbus domestica*). Planted in 2011, integrated production system.
	Romanel sur Morges	Agroforestry system with pollarded willow trees and fruit trees in combination with arable crops. Planted in 2015, organic farming system.
Lucerne	Grosswangen	Walnut and plum trees (*Prunus domestica*) in combination with an arable rotation comprising sown grassland pastured with chicken (fattening). Tree planting started in 2013, still ongoing. Organic farming system.
	Malters	Permaculture project with various fruit trees (mostly quince *Cydonia oblonga*), wild fruit trees, berries. Organic farming system.
	Sursee*	Apple trees (*Malus domestica*) in combination with potatoes, strawberries and sown flower strips. Established in 2009, integrated production system.
Geneva	Meinier	Agroforestry system with standard fruit trees and hedgerows in combination with an arable rotation. Planted in 2015, organic farming.
Zurich	Stadel	Planned agroforestry system with standard apple trees (*Malus domestica*) and special crops (berries). Organic farming system.
Neuchatel	Cressier	Apple (*Malus domestica*), wild cherry (*Prunus avium*) pear (*Pyrus communis*) in combination with an arable rotation. Planted in 2014 in cooperation with Frigemo SA (landowner). Integrated production system.
Aargau	Möhlin*	Sour cherry (*Prunus cerasus*), apple (*Malus domestica*), various wild fruit trees and shrubs (berries) in the tree line, in combination with horticulture and ecological focus areas. Trees were planted in 2009 and 2010. Organic farming system.
	Niederwil	Sweet chestnut (*Castanea sativa*) in combination with an arable rotation. Organic farming system.
Basel-Landschaft	Buus*	Poplar (*Populus tremula*) in combination with an arable rotation. Tree planting started in 2011, still ongoing. Trees not for short coppice but to grow up. Integrated farming system.

Table 2. Agroforestry plot features and parameters recorded on agroforestry plots of the Swiss participatory research and development network.

Feature or parameter	All agroforestry plots	Buus, Möhlin and Sursee plots
Characteristics of the agroforestry system, including digital map and tree co-ordinates	At tree planting	At tree planting
Soil characteristics	Soil core and spade probing, stability of soil aggregate (at time of tree planting)	Soil profile and lab analysis in2011
Plot management and yields	Annual	Annual
Farmer motivation and perception	Annual interviews	Annual interviews
Biodiversity	Overall evaluation	Overall evaluation
Tree measurements	No	Every three years, starting 2011
Machinery and labour input	Annual, based on farmer's records	Annual, based on farmer's records and on interviews

Figure 1: Farmer field day with agroforestry pioneers on the experimental plot Möhlin.

Agroforestry farmers are good observers. Each year we record their satisfaction and dis-satisfaction with particular features of their system (Figure 2). Overall, the (mostly still young tree-crop/animal) combinations evolve according to their expectations. They hardly notice competition for water, light or nutrients. They most critical point is the under-estimation of workload incurred by the trees. In particular, if the tree strip cannot be managed with sufficient care (keep the grass low), important mouse colonies establish and feed on tree roots. Fruit trees in particular, are susceptible to damage from mice and this is a major worry of Swiss agroforestry farmers.

As trees have only recently been planted (e.g. 2009 Möhlin system) and because the trees are comparatively slow growing, the full effects of the trees on the crop system will take time to develop.

Discussion and outlook

The measurements on the Buus, Möhlin and Sursee agroforestry plots (Table 1) have been initiated to allow for the parameterisation of the YieldSAFE model (van der Werf et al. 2007) with measured time series, for three tree species (apple, poplar, cherry). In 2017, three tree measurement points (2011, 2014, 2017) will be available as well as data on crops for seven years. It will be important to pursue those measurements. Agroforestry development requires a long-term perspective, both from farmers and from researchers.

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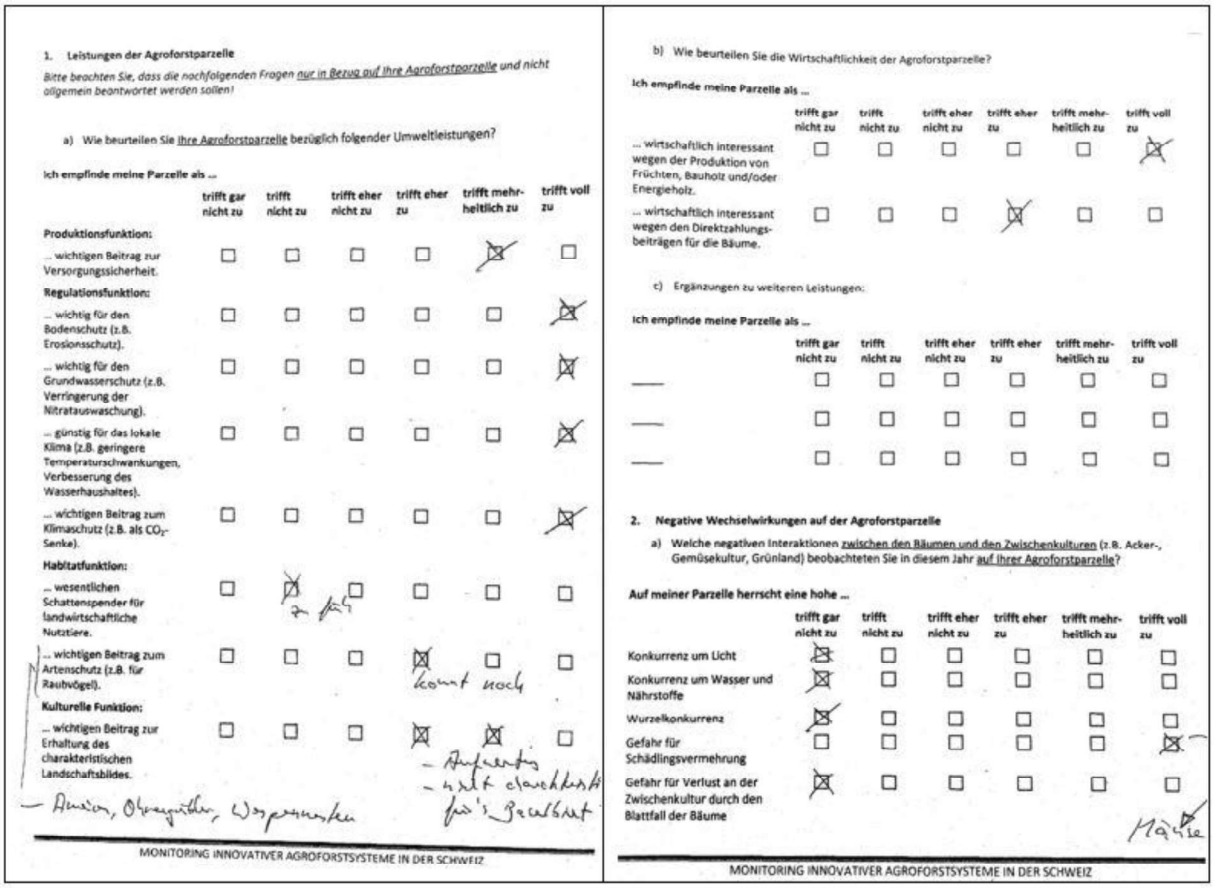

1. Leistungen der Agroforstparzelle

Bitte beachten Sie, dass die nachfolgenden Fragen nur in Bezug auf Ihre Agroforstparzelle und nicht allgemein beantwortet werden sollen!

a) Wie beurteilen Sie Ihre Agroforstparzelle bezüglich folgender Umweltleistungen?

Ich empfinde meine Parzelle als ...

	trifft gar nicht zu	trifft nicht zu	trifft eher nicht zu	trifft eher zu	trifft mehrheitlich zu	trifft voll zu
Produktionsfunktion:						
... wichtigen Beitrag zur Versorgungssicherheit.	☐	☐	☐	☐	☒	☐
Regulationsfunktion:						
... wichtig für den Bodenschutz (z.B. Erosionsschutz).	☐	☐	☐	☐	☐	☒
... wichtig für den Grundwasserschutz (z.B. Verringerung der Nitratauswaschung).	☐	☐	☐	☐	☐	☒
... günstig für das lokale Klima (z.B. geringere Temperaturschwankungen, Verbesserung des Wasserhaushaltes).	☐	☐	☐	☐	☐	☒
... wichtigen Beitrag zum Klimaschutz (z.B. als CO_2-Senke).	☐	☐	☐	☐	☐	☒
Habitatfunktion:						
... wesentlichen Schattenspender für landwirtschaftliche Nutztiere.	☐	☒ 2 Bäume	☐	☐	☐	☐
... wichtigen Beitrag zum Artenschutz (z.B. für Raubvögel).	☐	☐	☐	☒ kommt noch	☐	☐
Kulturelle Funktion:						
... wichtigen Beitrag zur Erhaltung des charakteristischen Landschaftsbildes.	☐	☐	☐	☒	☒ - Aufwertung - Attraktivität für's Grundstück	☐

— Amsel, Obstgarten, Wespennester

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b) Wie beurteilen Sie die Wirtschaftlichkeit der Agroforstparzelle?

Ich empfinde meine Parzelle als ...

	trifft gar nicht zu	trifft nicht zu	trifft eher nicht zu	trifft eher zu	trifft mehrheitlich zu	trifft voll zu
... wirtschaftlich interessant wegen der Produktion von Früchten, Bauholz und/oder Energieholz.	☐	☐	☐	☐	☐	☒
... wirtschaftlich interessant wegen den Direktzahlungsbeiträgen für die Bäume.	☐	☐	☐	☒	☐	☐

c) Ergänzungen zu weiteren Leistungen:

Ich empfinde meine Parzelle als ...

	trifft gar nicht zu	trifft nicht zu	trifft eher nicht zu	trifft eher zu	trifft mehrheitlich zu	trifft voll zu
____	☐	☐	☐	☐	☐	☐
____	☐	☐	☐	☐	☐	☐
____	☐	☐	☐	☐	☐	☐

2. Negative Wechselwirkungen auf der Agroforstparzelle

a) Welche negativen Interaktionen zwischen den Bäumen und den Zwischenkulturen (z.B. Acker-, Gemüsekultur, Grünland) beobachteten Sie in diesem Jahr auf ihrer Agroforstparzelle?

Auf meiner Parzelle herrscht eine hohe ...

	trifft gar nicht zu	trifft nicht zu	trifft eher nicht zu	trifft eher zu	trifft mehrheitlich zu	trifft voll zu
Konkurrenz um Licht	☒	☐	☐	☐	☐	☐
Konkurrenz um Wasser und Nährstoffe	☒	☐	☐	☐	☐	☐
Wurzelkonkurrenz	☒	☐	☐	☐	☐	☐
Gefahr für Schädlingsvermehrung	☐	☐	☐	☐	☐	☒
Gefahr für Verlust an der Zwischenkultur durch den Blattfall der Bäume	☒	☐	☐	☐	☐	☐

Mähre

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Figure 2. Example farmer perception questionnaire from one of the agroforestry plots.

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